

The 4-Bit COP400 Family: Optimized for Low-Cost Control

National's COP400 family offers the broadest range of low-priced, 4-bit microcontrollers on the market.

Key Features

- High-performance 4-bit microcontroller
- 4 μ s–16 μ s instruction-cycle time
- ROM-efficient instruction set
- On-chip ROM from 0.5k to 2k
- On-chip RAM from 32 x 4 to 160 x 4
- More than 60 compatible devices in family
- Common pin-outs
- NMOS and P²CMOST[™]
- MICROWIRE[™] serial interface
- Wide operating voltage range: +2.4V to +6.3V
- Military temp range available: –55°C to +125°C
- 20- to 28-pin packages
(incl. 20-, 24-pin SO and 28-pin PLCC)

And far from being "old technology," 4-bit microcontrollers are meeting significant market needs in more applications than ever before. In fact, National shipped more than 40 million 4-bit devices last year alone. The reason for the continuing strength of the COP400 family is its versatility. You can select from over 60 different, compatible devices. The first under 50¢ microcontroller set a new standard of value for cost/performance. You can select devices with a wide variety of ROM and RAM combinations, from 0.5k ROM and 32 x 4 RAM to 2k ROM and 160 x 4 RAM.

And every COP400 family member shares the same powerful, ROM-efficient instruction set and the same pin-out, so you can migrate between devices without re-engineering.

And like all of National's microcontrollers, the COP400 can be optimized to meet your specific application needs, with a variety of I/O options, pin-outs, and package types, from DIPs to SMDs.

COP[™] microcontrollers can be used to replace discrete logic in high-volume consumer products and low-volume industrial products allowing you to add features, miniaturize and reduce component count.

Key Applications

- Consumer electronics
- Automotive
- Industrial control
- Toys/games
- Telephones

Wide Acceptance

COPS wide acceptance comes from innovative products. National has built on this established family with continued and enhanced devices.

- The first under-a-dollar microcontroller led to a broader range of automotive and consumer applications.
- The first high-speed, low-power CMOS microcontrollers with 0.5k ROM provides design flexibility at low cost.
- The first microcontroller implementing MICROWIRE/PLUST[™] allowing two-way communication across only three lines.
- The first microcontroller implementing Post-Metal Programming (PMP[™]) for quick turns prototyping and production.

PMP

Post-Metal Programming (PMP), another NSC microcontroller first. Takes advantage of:

- Seasonal or volatile market demand
- Narrow windows of opportunity in highly competitive markets
- Simplified inventory control
- Reduced safety stock

Get all the advantages of custom-programmed microcontrollers with all the business advantages of low cost, quick-turn prototyping and production.

The secret is an entirely new process technology called Post-Metal Programming.

PMP (Continued)**INSIDE PMP**

Post-Metal Programming is a high energy implantation process that allows the ROM layer of a microcontroller to be programmed after final metallization. That means every die layer can be fully fabricated, except for the passivation layers, and held in inventory. Then when you request a ROM pattern, a ROM implant mask is generated and the buried ROM layer is programmed with an ion beam.

The wafer is passivated and cut into dice which are then packaged on a quick-turn line.

So in as little as two weeks, you've got prototypes.

See COP400 Family of Microcontroller selection

4-WEEK PRE-PRODUCTION QUANTITIES

Wafer fab accounts for the majority of prototyping and production time for integrated circuits.

With PMP, however, the dice are essentially complete and in inventory.

So we can take your approved prototypes right into full production or small quantity pre-production in as little as four weeks.

WINNING THE TIME-TO-MARKET RACE

The electronics market won't wait for anyone. If your competitors make a move, you've got to respond now.

You can't wait around for proof-of-design prototypes. Even a week can make a difference between success or failure. Between gaining market share or losing it. Between staying ahead of the other guys or falling behind. With PMP, you can stretch that lead by *weeks*. In fact, if you compare the quick-turn PMP process to conventional prototype-and-production timetables, you'll see that *you can actually gain as much as 3½ months over your competitors!*

NO EXTRA COST

PMP is available at *no extra cost*.

Compare that with the traditional "alternative" for quick-turn prototyping of user-programmable ROM. EPROM and EEPROM can easily drive your unit costs up to as much as \$6!

And when you consider the additional cost-savings of being able to reduce your safety stock in inventory, knowing you can get quick-turns in a few weeks, the PMP process and

National Semiconductor microcontrollers not only make good *engineering* sense, they make good *business* sense.

System Solutions

The COP400 family provides a flexible, cost-effective system solutions to all applications requiring timing, counting, or control functions.

And, bottom line, if a 4-bit controller can do the job, why pay more?

Development Support**DEVELOPMENT SYSTEM**

The Microcomputer On-Line Emulator Development System is a low cost development system and emulator for COPs microcontroller products. The Development System consists of a BRAIN Board, Personality Board and optional host software.

The purpose of the COP400 Development System is to provide the user with a tool to write and assemble code, emulate code for the target microcontroller and assist in both software and hardware debugging of the system.

It is a self contained computer with its own firmware which provides for all system operation, emulation control, communication, PROM programming and diagnostic operations. It contains three serial ports to optionally connect to a terminal, a host system, a printer or a modem or to connect to other Development Systems in a multi-Development System environment.

The Development System can be used in either a stand alone mode or in conjunction with a selected host system using PC-DOS communicating via a RS-232 port.

See AN-456 for more information.

HOW TO ORDER

To order a complete development package, select the section for the microcontroller to be developed and order the parts listed.

Microcontroller	Order Part Number	Description	Includes	Manual Number
COP400	MOLE-BRAIN	Brain Board	Brain Board Users Manual	420408188-001
	MOLE-COPS-PB1	Personality Board	COP400 Personality Board Users Manual	420408189-001
	MOLE-COPS-IBM	Assembler Software for IBM	COP400 Software Users Manual and Software Disk PC-DOS Communications Software Users Manual	424409479-002 420040416-001
	424410284-001	Programmers Manual		424410284-001

COP400 Family of Microcontrollers

Commercial Temp Version 0°C to +70°C	Industrial Temp Version -40°C to +85°C	Military Temp Version -55°C to +125°C	Technology	Description		Features								Development Tools		Data Sheet Page	
				Memory		I/O		Interrupt	Stack	Time Base Counter	Micro Bus	Typ. 5V Operat. Power	Max Standby at 3.3V	Size (Pins)	ROMless Device		Piggyback
				ROM (Bytes)	RAM (Digits)	I/O Plns	Serial I/O										
COP413L*	COP313L		NMOS Low Power	0.5k	32	15	Yes	No	2 Level	No	No	15 mW	7.5 mW	20	COP401L- X13/R13		1-59
COP414L*	COP314L		NMOS Low Power	0.5k	32	15	Yes	No	2 Level	No	No	15 mW	7.5 mW	20	COP401LN		1-86
COP410L	COP310L		NMOS Low Power	0.5k	32	19	Yes	No	2 Level	No	No	15 mW	7.5 mW	24	COP401LN		1-41
COP411L	COP311L		NMOS Low Power	0.5k	32	16	Yes	No	2 Level	No	No	15 mW	7.5 mW	20	COP401LN		1-41
COP413C	COP313C		CMOS Low Power	0.5k	32	15	Yes	No	2 Level	No	No	1 mW	0.1 mW	20	COP404CN	COP444CP	1-72
COP413CH	COP313CH		CMOS Hi Speed	0.5k	32	15	Yes	No	2 Level	No	No	1 mW	0.1 mW	20	COP404CN	COP444CP	1-72
COP410C	COP310C		CMOS Hi Speed	0.5k	32	19	Yes	No	2 Level	No	No	1 mW	0.1 mW	24	COP404CN	COP444CP	1-26
COP411C	COP311C		CMOS Hi Speed	0.5k	32	16	Yes	No	2 Level	No	No	1 mW	0.1 mW	20	COP404CN	COP444CP	1-26
COP420	COP320		NMOS Hi Speed	1.0k	64	23	Yes	1 Source	3 Level	Yes	No	100 mW	N/A mW	28	COP402N-5	COP420P	1-101
COP421	COP321		NMOS Hi Speed	1.0k	64	19	Yes	No	3 Level	Yes	No	100 mW	N/A mW	24	COP402N-5	COP420P	1-101
COP422	COP322		NMOS Hi Speed	1.0k	64	16	Yes	No	3 Level	Yes	No	100 mW	N/A mW	20	COP402N-5	COP420P	1-101
COP424C*	COP324C	COP224C (Note 1)	CMOS Hi Speed	1.0k	64	23	Yes	1 Source	3 Level	Yes	Yes	1 mW	0.1 mW	28	COP404CN	COP444CP	1-152
COP425C*	COP325C	COP225C (Note 1)	CMOS Hi Speed	1.0k	64	19	Yes	No	3 Level	Yes	No	1 mW	0.1 mW	24	COP404CN	COP444CP	1-152
COP426C*	COP326C	COP226C (Note 1)	CMOS Hi Speed	1.0k	64	16	Yes	No	3 Level	Yes	No	1 mW	0.1 mW	20	COP404CN	COP444CP	1-152
COP420L*	COP320L		NMOS Low Power	1.0k	64	23	Yes	1 Source	3 Level	Yes	Yes	45 mW	9.9 mW	28	COP404L SN-5	COP444LP	1-125
COP421L*	COP321L		NMOS Low Power	1.0k	64	19	Yes	No	3 Level	Yes	No	45 mW	9.9 mW	24	COP404L SN-5	COP444LP	1-125
COP422L*	COP322L		NMOS Low Power	1.0k	64	16	Yes	No	3 Level	Yes	No	45 mW	9.9 mW	20	COP404L SN-5	COP444LP	1-125
COP444C*	COP344C	COP244C (Note 1)	CMOS Hi Speed	2.0k	128	23	Yes	1 Source	3 Level	Yes	Yes	1 mW	0.1 mW	28	COP404CN	COP444CP	1-152
COP445C*	COP345C	COP245C (Note 1)	CMOS Hi Speed	2.0k	128	19	Yes	No	3 Level	Yes	No	1 mW	0.1 mW	24	COP404CN	COP444CP	1-152
COP444L	COP344L		NMOS Low Power	2.0k	128	23	Yes	1 Source	3 Level	Yes	No	65 mW	9.9 mW	28	COP404L SN-5	COP444LP	1-172
COP445L	COP345L		NMOS Low Power	2.0k	128	19	Yes	No	3 Level	Yes	No	65 mW	9.9 mW	24	COP404L SN-5	COP444LP	1-172

Note 1: Datasheet found on page 1-8.

*Microcontrollers available with Quick-Turns Post-Metal Programming (PMP).

COPS Family Development Tools

COPS Family Development Tools

Commercial Temp Version 0°C to +70°C			Technology	Description		Features						Supplementary Description	Data Sheet Page			
				ROM (Bytes)	Memory	I/O		Interrupt	Stack	Time Base Counter	Micro Bus			Typ. 5V Operat. Power	Max Standby at 3.3V	Size (Pins)
						I/O Pins	Serial I/O									
ROMless																
COP401L-X13			NMOS Low Power	0.5k	32	16	Yes	No	2 Level	No	No	100 mW	7.5 mW	40	Has XTAL Oscillator Option	1-210
COP401L-R13			NMOS Low Power	0.5k	32	16	Yes	No	2 Level	No	No	100 mW	7.5 mW	40	Has RC Oscillator Option	1-210
COP401L			NMOS Low Power	0.5k	32	16	Yes	No	2 Level	No	No	100 mW	7.5 mW	40	ROMless Version of COP410L	1-196
COP402-5			NMOS Hi Speed	1.0k	63	20	Yes	1 Source	3 Level	Yes	No	50 mW	N/A mW	40	Has Interrupt, No Microbus	1-223
COP404LSN-5			NMOS Low Power	1.0k	128	20	Yes	1 Source	3 Level	Yes	No	125 mW	N/A mW	40	W/Push-Pull Mem Interface	1-257
COP404C			CMOS Hi Speed	2.0k	128	23	Yes	1 Source	3 Level	Yes	Yes	1 mW	0.1 mW	48	CMOS ROMless Device	1-240
PIGGYBACK																
COP420P			NMOS Hi Speed	1.0k	64	23	Yes	3 Sources	3 Level	Yes	No	50 mW	N/A mW	28	Includes: CPU, RAM, I/O	1-271
COP444LP			NMOS Low Power	2.0k	128	23	Yes	3 Sources	3 Level	Yes	No	125 mW	N/A mW	28	and EPROM Socket	1-271
COP444CP			CMOS Hi Speed	2.0k	128	23	Yes	1 Source	3 Level	Yes	Yes	1 mW	1 mW	28	Will Accept Standard EPROM	1-271

DIAL-A-HELPER

Dial-A-Helper is a service provided by the Microcontroller Applications group. The Dial-A-Helper is an Electronic Bulletin Board Information System and additionally, provides the capability of remotely accessing the MOLE development system at a customer site.

INFORMATION SYSTEM

The Dial-A-Helper system provides access to an automated information storage and retrieval system that may be accessed over standard dial-up telephone lines 24 hours a day. The system capabilities include a MESSAGE SECTION (electronic mail) for communications to and from the Microcontroller Applications Group and a FILE SECTION which consists of several file areas where valuable application software and utilities could be found. The minimum requirement for accessing the Dial-A-Helper is a Hayes compatible modem.

Voice: (408) 721-5582

Modem: (408) 739-1162

Baud: 300 or 1200 baud

Set-Up: Length: 8-bit

Parity: None

Stop bit: 1

Operation: 24 hrs., 7 days

If the user has a PC with a communications package then files from the FILE SECTION can be down loaded to disk for later use.

Order P/N: MOLE-DIAL-A-HLP

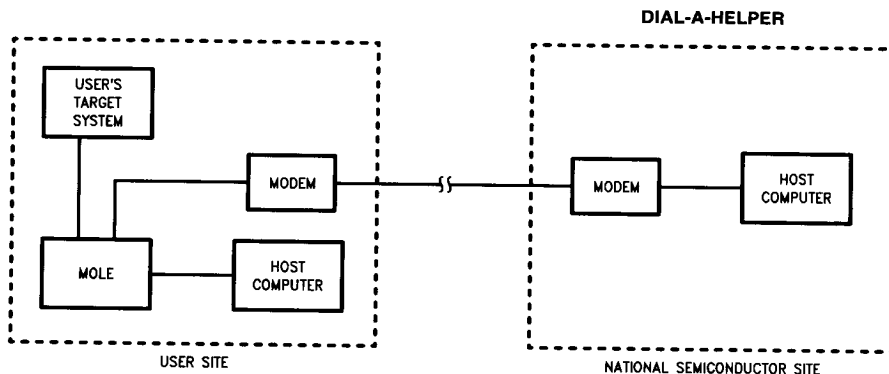
Information System Package Contains

DIAL-A-HELPER Users Manual P/N

Public Domain Communications Software

FACTORY APPLICATIONS SUPPORT

Dial-A-Helper also provides immediate factory applications support. If a user is having difficulty in operating a MOLE, he can leave messages on our electronic bulletin board, which we will respond to, or under extraordinary circumstances he can arrange for us to actually take control of his system via modem for debugging purposes.



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